AD-A128 644 VIBRATION TEST MK-82 BOMB STAMP STRAP(U) AIR FORCE PACKAGING EVALUATION AGENCY WRIGHT-PATTERSON AFB OH E J KOWALSKI 18 MAR 83 PTPD-83-R-01 1/1

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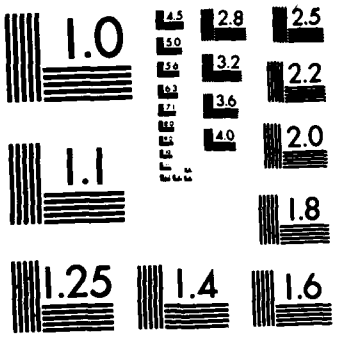

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PTPD Report No. 83-R-01
AFPEA Project No. 83-P7-104

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VIBRATION TEST MK-82 BOMB STAMP STRAP

AFALD/PTPD
Air Force Packaging Evaluation Agency
Wright-Patterson AFB OH 45433

March 1983

NOTICE

ABSTRACT

The Stamp Strap Program requires that Live All-Up Round Configuration MK-82 Bombs be shipped by aircraft for rapid deployment. There is, however, concern that the vibration caused by the aircraft on the MK-82 bombs with fins may have an effect on the safety of personnel and aircraft.

Vibration tests were conducted on palletized inert MK-82 bombs with fins IAW a modified Method 5020.1 vibration test of Federal Test Method Standard No. 101.

Although the vibrations developed during aircraft shipments may not be as severe as those developed during the tests, there is concern whether damage could occur to the propellant, igniter, squib, fuze or if preignition could occur in shipment.

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PUBLICATION DATE:
18 MAR 1983

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TABLE OF CONTENTS

	Page
ABSTRACT	i
TABLE OF CONTENTS	ii
INTRODUCTION	1
BACKGROUND	1
PURPOSE	1
TEST SPECIMENS	1
TEST OUTLINE AND TEST EQUIPMENT	1
TEST PROCEDURE AND RESULTS	1
TEST NO. 1	1
TEST NO. 2	2
CONCLUSION	2
RECOMMENDATION	2
FIGURE 1, ALL-UP ROUND MK-82 BOMB WITH CONICAL FINS MK-15	3
FIGURE 2, PALLET MHU-149/E WITH MK-82 BOMBS	3
FIGURE 3, CONICAL FINS MK-15 ASSEMBLED TO MK-82 BOMBS BEFORE VIBRATION TEST NO. 1	3
FIGURE 4, PALLETS MHU-149/E ASSEMBLED ON 463L ON VIBRATION TESTING MACHINE	4
FIGURE 5, TIE-DOWN OF PALLETS MHU-149/E TO 463L SYSTEM	4
FIGURE 6, TIE-DOWN OF PALLETS MHU-149/E TO 463L SYSTEM	4
FIGURE 7, MK-82 BOMB ROTATION, CLOCKWISE DIRECTION, END OF TEST NO. 1	5
FIGURE 8, MK-82 BOMB MOVEMENT, HORIZONTAL DIRECTION, END OF TEST NO. 1	5
FIGURE 9, MK-82 BOMB MOVEMENT, HORIZONTAL DIRECTION, END OF TEST NO. 1	5
FIGURE 10, FIN COVER PLATE FOR THE ATC-35 VIBRATED LOOSE DURING TEST NO. 1	6

Page

FIGURE 11, SADDLES LINED WITH SELF ADHESIVE NEOPRENE SPONGE RUBBER FOR TEST NO. 2 6

FIGURE 12, SADDLES LINED WITH SELF ADHESIVE NEOPRENE SPONGE RUBBER FOR TEST NO. 2 6

FIGURE 13, 1/2 INCH BOLT THRU FORWARD LUG AND CROSS-MEMBER OF PALLET TO RETAIN MK-82 BOMB IN STATIONARY POSITION, TEST NO. 2 7

FIGURE 14, END OF TEST NO. 2, MK-82 BOMBS WITH RETARD FINS MAU-93 7

FIGURE 15, DETERIORATION OF NEOPRENE SPONGE RUBBER END OF TEST NO. 2 7

FIGURE 16, DETERIORATION OF NEOPRENE SPONGE RUBBER END OF TEST NO. 2 8

FIGURE 17, SKETCH OF RECTANGULAR SLOTS IN CROSS MEMBER OF MAU-149/E PALLET 9

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INTRODUCTION

BACKGROUND: The Stamp Strap Program requires that the all-up round configuration MK-82 bombs be shipped by C-5 and C-141 aircraft for rapid deployment. There is however, concern that vibrations caused in aircraft shipments may have a detrimental effect on the safety of personnel and aircraft.

PURPOSE: The purpose of this project was to determine if the MK-82 bombs could be shipped in an all-up round configuration on the MHU-149/E pallets without damage to the pallet, the MK-82 bomb, and the fins.

TEST SPECIMENS: Two each pallets MHU-149/E for the MK-82 bombs and twelve each retard fins MAU-93 were furnished by OO-ALC/DSY, Hill AFB UT 84406. Twelve each insert MK-82 bombs and twelve each conical fins MK-15 were furnished by the 71st Ordnance Detachment/EOD, WPAFB OH 45433 for these tests.

Assembly of the fins to the MK-82 bombs (Figure 1 and 3, Assembly of the MK-82 Bombs, with Fins on the Pallets (Figure 1 and 2) and the tie-down of the pallets (simulated as for aircraft shipment) on the 463L System (Figure 4, 5 and 6) was accomplished by personnel from OO-ALC/DSY, Hill AFB UT 84406.

TEST OUTLINE AND TEST EQUIPMENT: Tests were conducted in accordance with a modified Federal Test Method Standard (FTMS) No. 101, Method 5020.1, Vibration (Sinusoidal Motion). Both tests were conducted at a logarithmic sweep rate of ½ octave per minute over a frequency range of 2 to 64 Hz and return for a period of 2 hours. The platform amplitude generated a 0.2 to 1.0 G peak acceleration during the test. The resonant frequencies were obtained and the pallets were vibrated an additional 15 minutes at each of the indicated resonant frequencies.

The equipment used for the tests was a 150,000 pound capacity, shock and vibration testing system, MTS closed loop electrohydraulic testing machine (Figure 4).

TEST PROCEDURE AND RESULTS

TEST NO. 1: The first sequence of testing was conducted on the MK-82 bombs with the conical fins MK-15. Two pallets with the MK-82 bombs were mounted on the 463L pallet as shown on Figure 4. The modified FTMS No. 101, Method 5020.1 Vibration (Sinusoidal Motion) test was conducted for a period of two hours. At the end of the two hour test, resonant frequencies were found at 11, 15, 19 and 22 Hz and the test was continued for an additional fifteen minutes at each of the resonant frequencies.

RESULTS: It was noted that at the initial start of the test and at 16 Hz the inner (upper and lower) bombs on both pallets began to rotate in a clockwise direction (Figure 7). Forward movement was also noted during the two hour test period. The bomb movements were in a horizontal direction from a minimum of 1/8 inch to a maximum of 4-1/4 inches (Figure 8 and 9).

Cover plates for the ATC-35 had also vibrated loose on two of the fins MK-15 (Figure 10). During the resonant frequency test at 11 Hz the bombs vibrated with such movement that it caused the fins of the bombs to strike each other. Visual inspection of the items at the end of the tests did not reveal any physical damage to the pallets, MK-82 bombs or the fins MK-15.

TEST NO. 2: For the second sequence of tests the pallets were modified as follows. One pallet set was modified by lining the upper and lower saddles with a self adhesive neoprene sponge rubber, 3/16 inch thick and 1-1/2 inch wide (Figure 11 and 12). One pallet set was modified by drilling a 9/16 inch hole below the saddle of the cross-member. The forward lug on the MK-82 bomb was then held in position by a 1/2 inch diameter bolt (Figure 13).

The conical fins MK-15 were removed and replaced by the retard fins MAU-93. The bombs were placed on the pallets and mounted on the 463L pallet. The pallets were then vibrated for two hours at the same frequencies as in Test No. 1. At the end of the two hour test resonant frequencies were found at 12, 15, 18 and 20 Hz and the test was continued for an additional fifteen minutes at each of the resonant frequencies.

RESULTS: A slight rotation was noted on the fins MAU-93 lower right bomb, left pallet (Figure 14), however, this was a result of the initial placement of the bomb on the pallet and not a result of the testing. The tape marking on the upper left bomb, right pallet, is not in a perfect vertical position. This is also a result of the initial placements of the tape on the nose of the bomb and not a result of the testing. No rotation was noted during the modified pallet testing (left pallet neoprene sponge rubber on saddles, right pallet lugs held in position by 1/2 inch diameter bolt), however, the bombs did move in a horizontal direction on the neoprene sponge rubber modified pallets. The bomb movements were in a horizontal direction from a minimum of 3/16 inch to a maximum of 15/16 inch. During the resonant frequency test at 12 Hz the bombs vibrated with such movement that it caused the fins of the bombs to strike each other. Visual inspection of the items at the end of the tests did not reveal any physical damage to the pallets, MK-82 bombs or the fins MAU-93.

Deterioration of the neoprene sponge rubber was noted at the end of the test (Figure 15 and 16).

CONCLUSION: Method 5020.1 Vibration (Sinusoidal Motion) of Federal Test Method Standard No. 101 was modified for this project. Although the modified test was less severe than the original Method 5020.1, the palletized MK-82 bombs experienced rotational and horizontal movement. It is assumed that these conditions of vibration would not exist for the extended periods of time during deployment in the C-5 and C-141 aircraft. However, in an all-up live round configuration we cannot state what may happen to the propellant, igniter, squib, fuze or if preignition could occur from the vibrations at take-off or in transit.

RECOMMENDATION: To keep the bombs from rotational and horizontal movement and to stabilize the load on the pallets it is recommended that future designs of pallets include rectangular slots in the saddles of the pallet cross-members to accept both the forward and aft mounting lugs (Figure 17).

Figure 1. All-Up Round MK-82 Bomb With Conical Fins MK-15

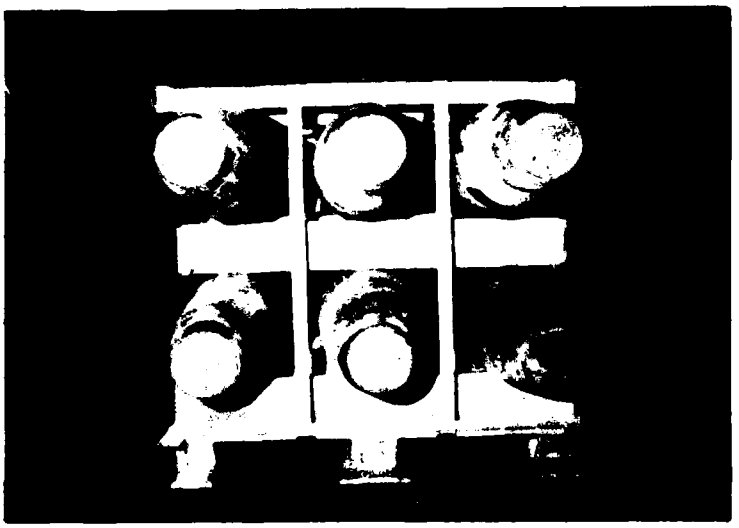


Figure 2. Pallet MHU-149/E With MK-82 Bombs

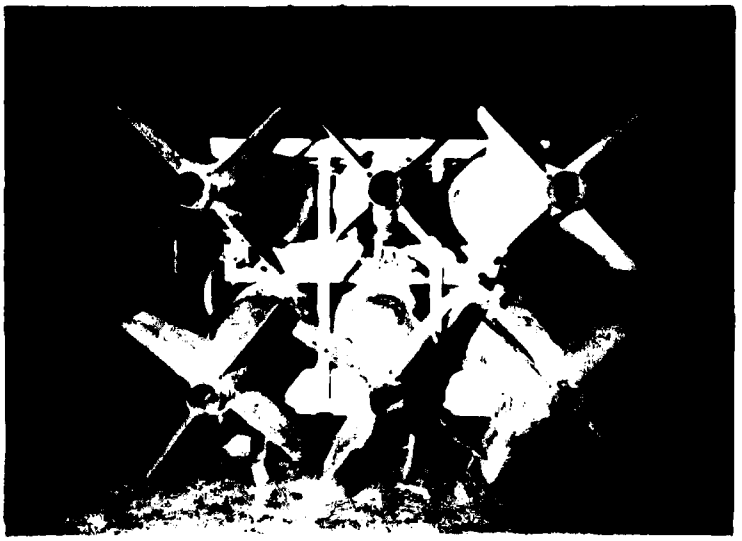


Figure 3. Conical Fins MK-15 Assembled to MK-82 Bombs Before Vibration Test No. 1

Figure 4. Pallets MHU-149/E Assembled on 463L on Vibration Testing Machine

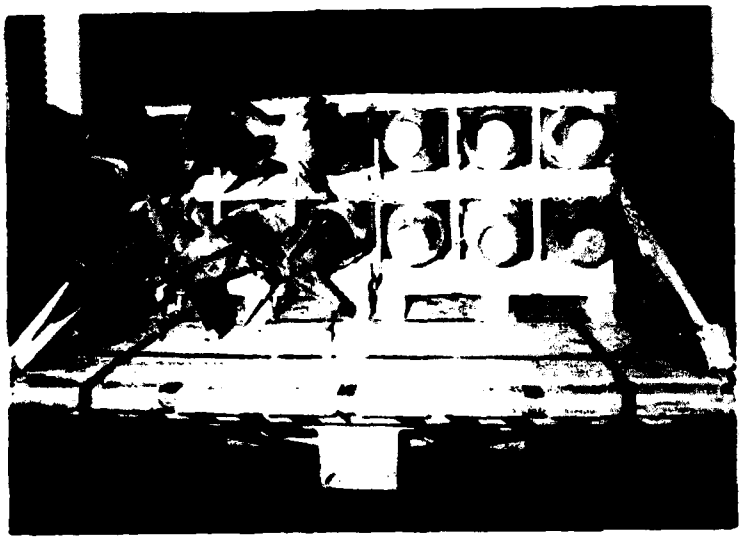


Figure 5. Tie-down of Pallets MHU-149/E to 463L System

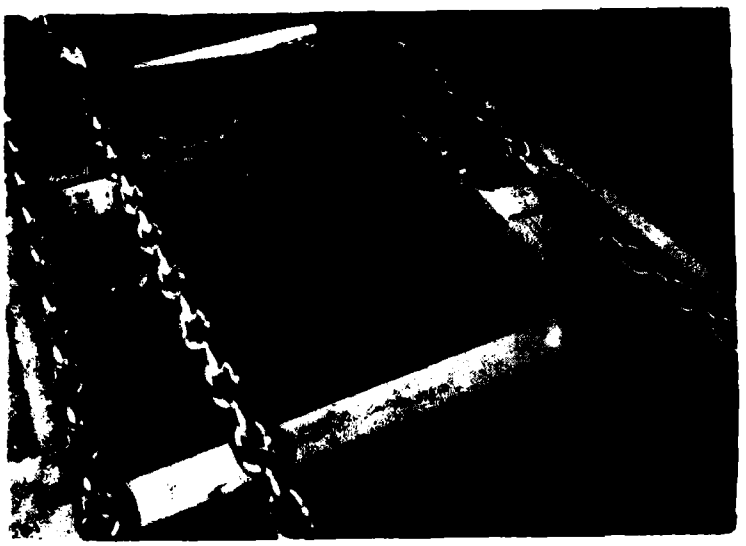


Figure 6. Tie-down of Pallet MHU-149/E to 463L System

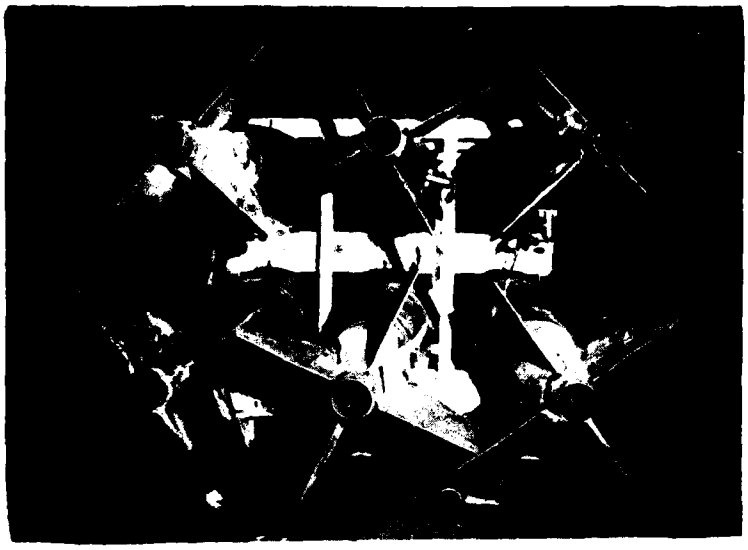


Figure 7. MK-82 Bomb Rotation, Clockwise Direction, End of Test No. 1

Figure 8. MK-82 Bomb Movement, Horizontal Direction, End of Test No. 1

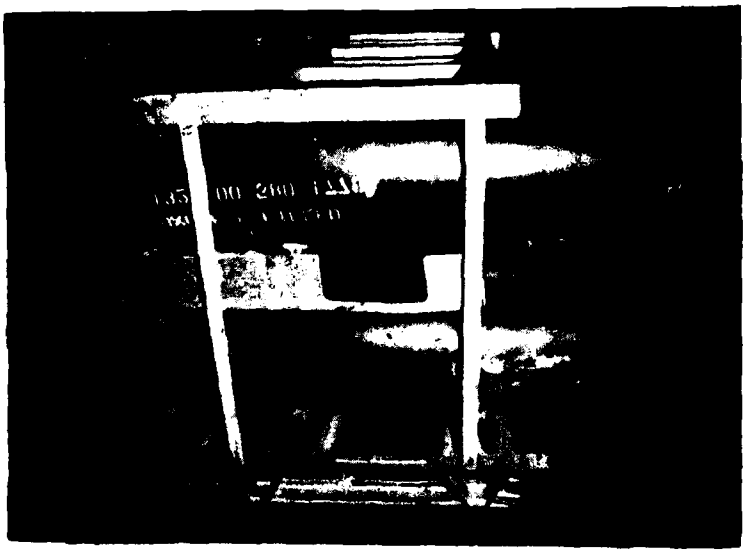


Figure 9. MK-82 Bomb Movement, Horizontal Direction, End of Test No. 1

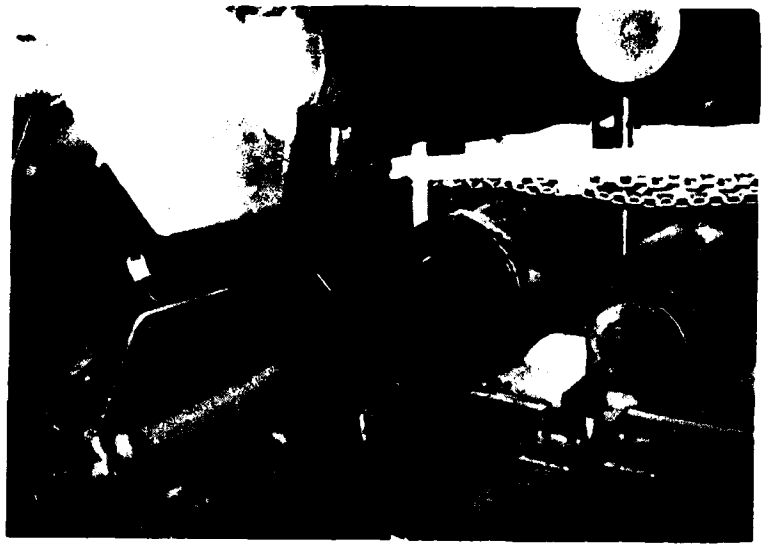


Figure 10. Fin Cover Plate for the ATC-35 Vibrated Loose During Test No. 1

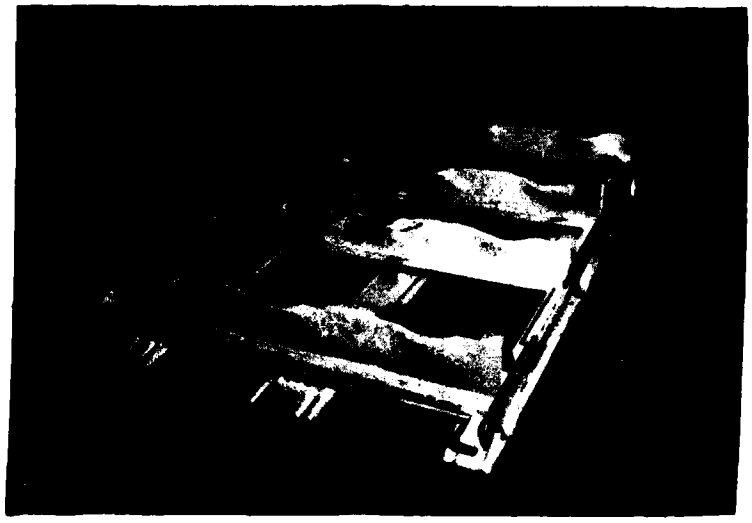


Figure 11. Saddles Lined With Self Adhesive Neoprene Sponge Rubber for Test No. 2

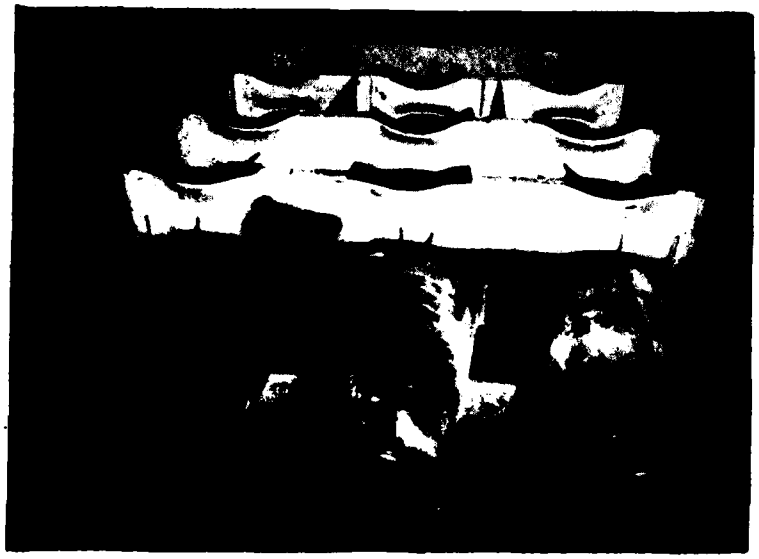


Figure 12. Saddles Lined With Self Adhesive Neoprene Sponge Rubber for Test No. 2

Figure 13. 1/2 Inch Bolt Thru Forward Lug and Cross-Member of Pallet to Retain MK-82 Bombs in Stationary Position, Test No. 2

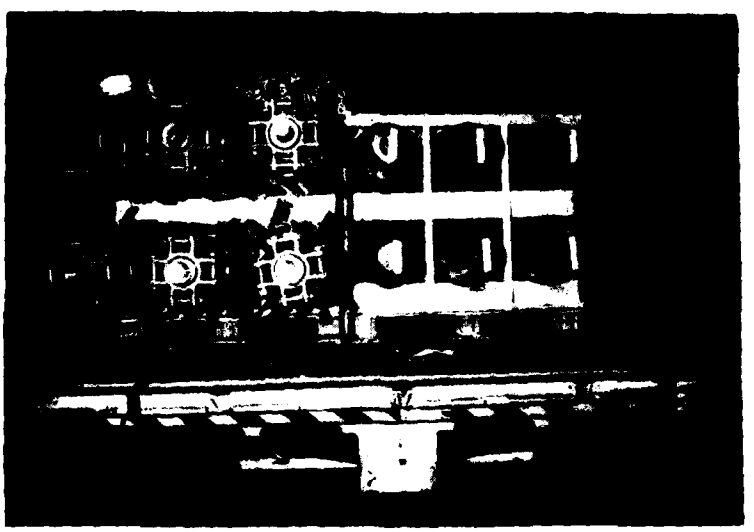


Figure 14. End of Test No. 2 MK-82 Bombs With Retard Fins MAU-93

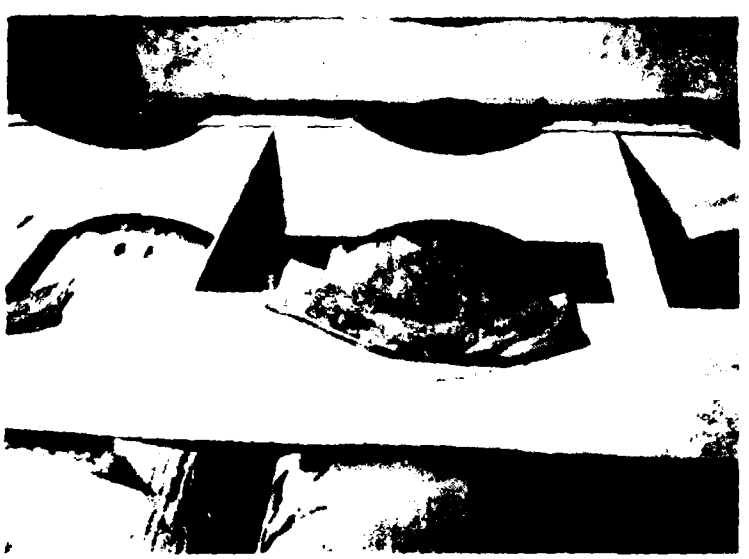


Figure 15. Deterioration of Neoprene Sponge Rubber End of Test No. 2

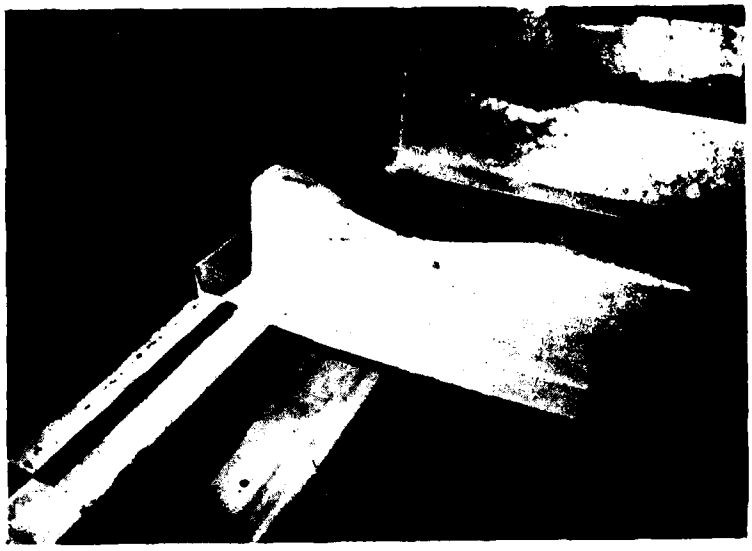
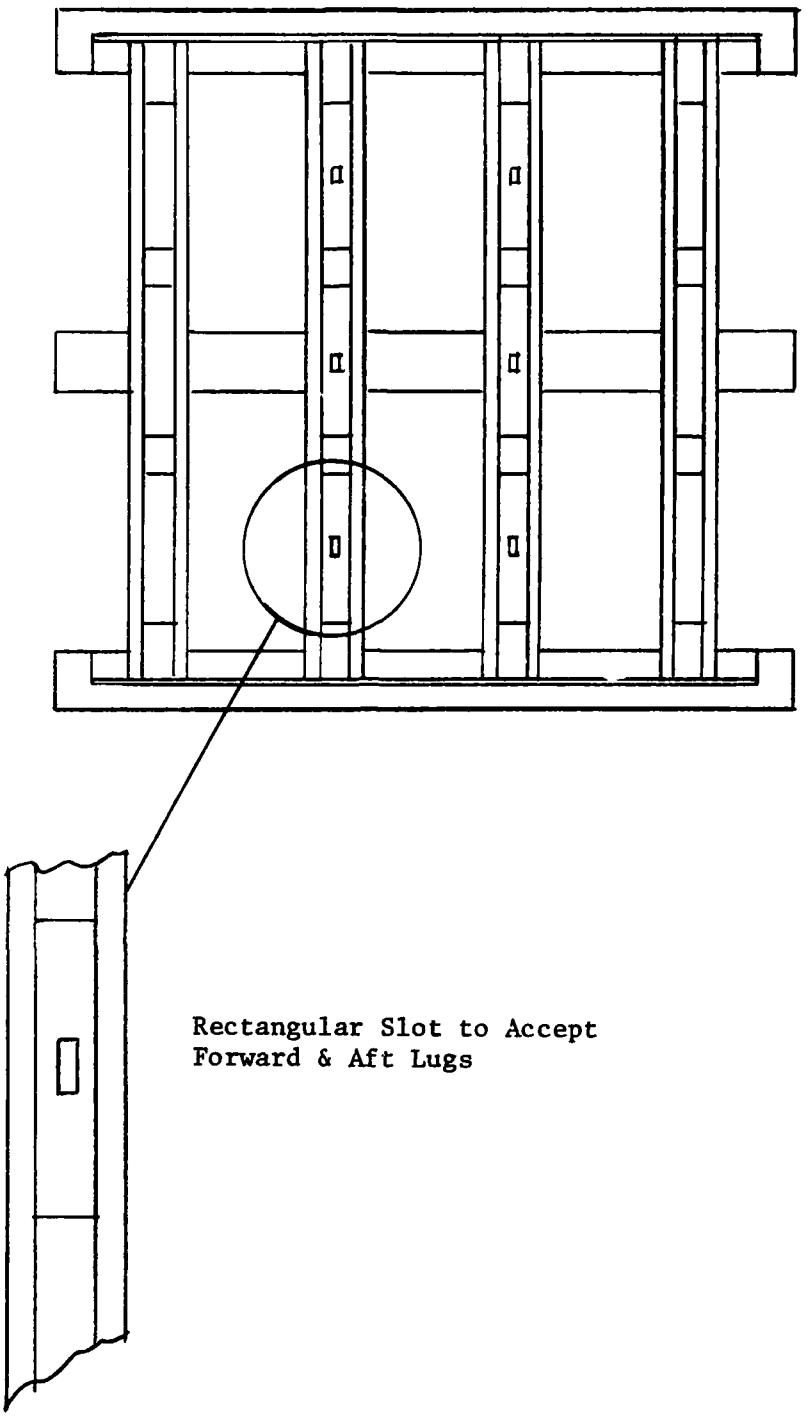


Figure 16. Deterioration of Neoprene Sponge Rubber End of Test No. 2



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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER PTPD Report No. 83-R-01	2. GOVT ACCESSION NO. AD-A128 694	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* VIBRATION TEST MK-82 BOMB STAMP STRAP		5. TYPE OF REPORT & PERIOD COVERED Final March 1983 6. PERFORMING ORG. REPORT NUMBER AFPEA Project No. 83-P7-104
7. AUTHOR(s) EDWARD J. KOWALSKI		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS AFALD/PTPD Air Force Packaging Evaluation Agency Wright-Patterson AFB OH 45433		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Deputy for Product Evaluation Engineering & Test AFALD/PT, Wright-Patterson AFB OH 45433		12. REPORT DATE 18 March 1983 13. NUMBER OF PAGES 10
14. MONITORING AGENCY NAME & ADDRESS*(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

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17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Bomb MK-82
Pallets, Vibration Test

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

The stamp strap program requires that live all-up round configuration MK-82 bombs be shipped by aircraft for rapid deployment.
Vibration tests were conducted on palletized inert MK-82 bombs with fins IAW a modified method 5020.1 of federal test method standard no. 101. Although the vibrations developed during aircraft shipments may not be as severe as those developed during the tests, there is concern whether damage could occur to the propellant, igniter, squip, fuze or if preignition could occur in shipment.

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